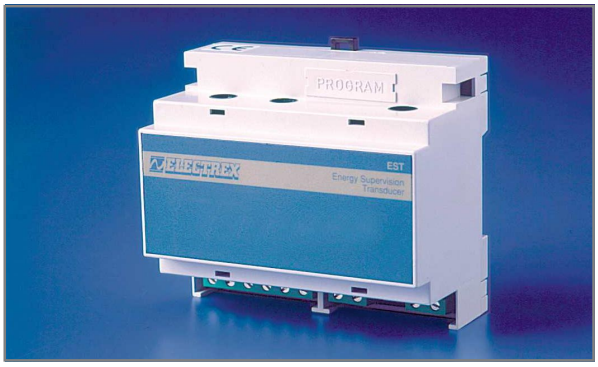
ELECTREX

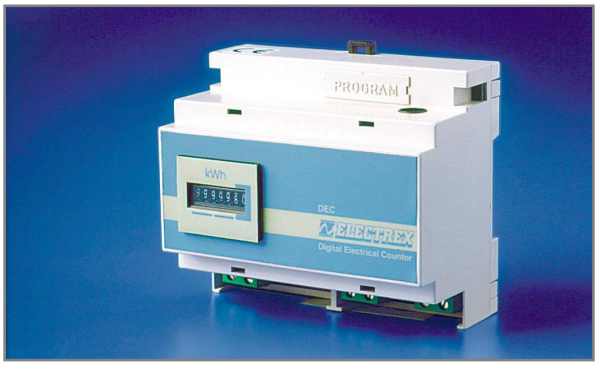
ENGLISH

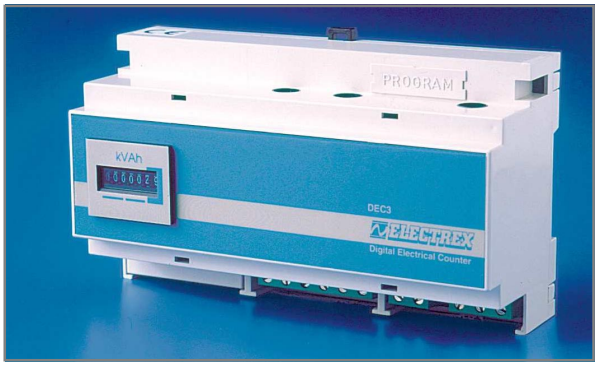
DEPT



EST

DEC





DEC3

ELECTREX

USER MANUAL

energy with imagination

INDEX

TERMS OF WARRANTY

The warranty is valid starting from the manufacturing date, as evidenced on the receipt of the calibration certificate, for the period indicated on the package. If not specified, the warranty will cover the equipment for a year from the purchasing date, anyway not over 18 months from the manufacturing date.

The warranty covers the free repair or substitution of equipment parts which are recognized as faulty due to manufacturing defects.

The warranty does not cover those parts which result defective due to negligent or improper use, incorrect installation or maintenance, operation by unauthorized personnel, damage during transportation, or which in any case do not indicate manufacturing defects of the equipment. Also excluded from the warranty are technical interventions regarding the installation of the equipment. Also excluded from the warranty are technical interventions regarding the installation of the equipment to the electrical system.

The manufacturer declines any responsability for eventual injury or damage to persons, animals or things as result of failure to follow the instructions in the Instructions Manual or caused by improper use of the equipment.

The warranty covers equipment returned ex works. The expenses of transport as well as the relative risks of same, both to and from the place of repair, will be the sole responsability of the User. This warranty expires after the date of purchase and any assistance required after said date including spare parts, labor, transport of personnel and materials will be charged to the User basated on the tariffs in force for Technical Assistance Service at the time of such requested service. In any case the substitution of the equipment as well as the extension of the warranty after such breakdown is excluded.

CE

ELECTREX hereby declares that its range of transducers complies with the EMC requirements of Directive 89/336/EEC and also the requirements of the following standards:

EMISSIONS = EN 50081-1 1992
[EN 55022-CLASS B
CI S PR 22]

IMMUNITY= EN 50082-1(light industry) 1992
EN 50082-2 (heavy industry) 1994

IEC 1000-4-4 2kV on signals 4kV on power supply

SAFETY= IEC 1010

COMPLIANCE WITH IEC 1036 DIRECTIVE = energy measurement, CLASS 1 accuracy

The packaging of each instrument bears a "CE" mark of conformity.

1 SAFETY

☞ This instrument was manufactured and tested in compliance with class 2 IEC 1010 and VDE 411 standards, in accordance with group C VDE 0110 standards for operating voltages up to 500 VACrms. Quality and accuracy are guaranteed by an ISO9000 certified production structure which utilizes the latest surface mounting techniques, therefore the instrument left the factory in perfect condition regarding technical safety.

In order to maintain this condition and to ensure safe operation, the user must comply with the indications and markings contained in the following instructions:

- When the instrument is received, before beginning installation, check that it is still intact and no damage was incurred during transport.
- Before mounting, ensure that the operating voltage and mains voltage set are the same, and then proceed with installation.
- The instrument unit is double insulated and does not require an earth connection. The power supply must be connected to phase and neutral as shown in the relevant diagram.
- A 50 mA T type HBC fuse should be installed in the power supply circuit to the instrument.
- The power supply must be connected before the measurement circuit.
- Before any maintenace and/or repairs, whenever the instmrument must be opened, it must be disconnected from all power sources.
- The instrument's capacitors may still be charged even after it has been disconnected from all power sources.
- Maintenance and/or repairs must be carried out only by qualified, authorized personnel.
- If there is ever the suspicion that safe use is no longer possible, the instrument must be taken out of service and precautions taken against accidental use.
- Operation is no longer safe when:

1) There is clealy visible damage.
2) The instrument no longer functions.

3) After lengthy storage in unfavorable conditions.

4) After serious damage incurred during transport.

1.1 Operator safety

☞ *Read these pages carefully before installing and utilising the instrument*

The instrument described in this user manual is intended for use by properly trained staff only. Maintenace and/or repairs must be carried out only by authorized personnel.

For proper, safe use of the instrument and for maintenace and/or repair, it is essential that the persons instructed to carry out these procedures follow normal safety precautions.

1.2 Symbols


READ THE INSTRUCTIONS

1.3 Precautions in case of breakdowns

If it is suspected that the instrument is no longer safe, for example due to damage incurred during transport or use, it must be taken out of service and precautions taken to prevent accidental use.
Contact authorized technicians for checks and any repairs.

2 PRESENTATION

Sophisticated engineering backed by years of specialist experience in the electronics and electrotechnical sector have enabled ELECTREX to develop an innovative range of programmable microprocessor-based transducers for electrical parameters whose outstanding versatility and ease-of-application satisfy a wide range of customer requirements in terms of electrical parameter control and energy cost management.
Advanced auto-compensation technology guarantees excellent measurement reliability and stability, even in the most adverse operating conditions. Instruments are housed in a modular-designed case (6 modules for DEPT - EST - DEC; 9 modules for DEC-3) suitable DIN rail mounting (35 mm rail). All circuits and internal insulation comply with industrial grade international standards (IEC 1010 - VDE 411, Class 2).
Instruments are suitable for installation in singlephase, balanced three-phase (DEPT and DEC) or unbalanced three-phase 4-wire star and 3 -wire delta (EST and DEC-3) networks.
Measurements are RMS values with automatic current (3 scales) and voltage (2 scales) scale change. Functions are easily selected by dip-switch.

The following models are available :

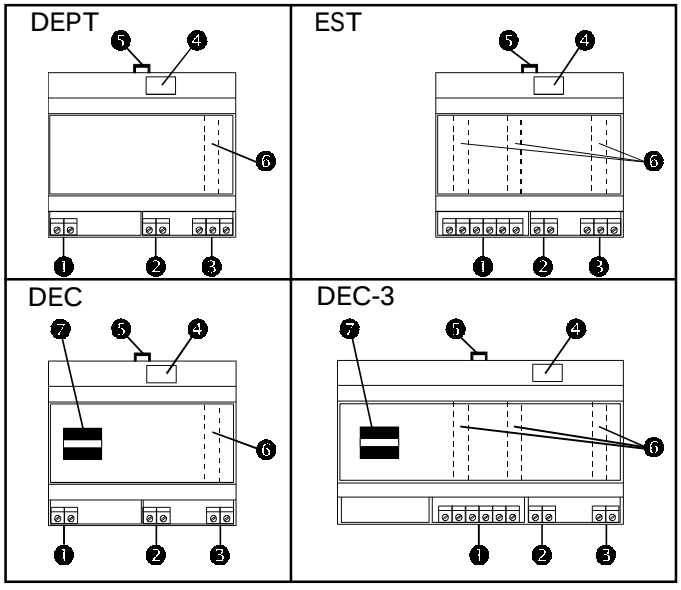
DEPT: Digital electrical parameter transducer for installation in Single-phase or balanced Three-phase networks (available with 4-20 mA signal output, pulse output or RS485 data output).

EST: Energy supervision transducer for installation in unbalanced Three-phase 4-wire star or 3-wire delta networks (available with 4-20 mA signal output, pulse output or RS485 data output).

DEC: Digital energy counter for installation in Single-phase or balanced Three-phase networks (available with pulse output or RS485 data output).

DEC-3: Three-phase digital energy counter for installation in unbalanced Three-phase 4-wire star or 3-wire delta networks (available with pulse output or RS485 data output).

2.1 Instrument description



① *Voltage input terminals*
② *Power supply terminals*
③ *Output terminals*
④ *Function selection dip-switch*
⑤ *DIN rail mounting hook*
⑥ *Cable holes for CT secondary cables*
⑦ *7-digit electro-mechanical counter*

2.2 DIN RAIL MOUNTING

Raise the black plastic hook on the botton of the instrument using a screwdriver and fit it onto the rail (see Fig. 1).

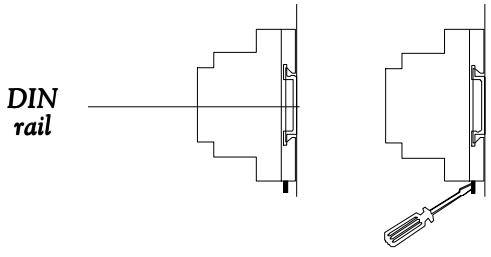


Fig. 1

2.3 POWER SUPPLY

IMPORTANT: *Before powering up the instrument set the operating functions using the 8-pole dip-switch as described in chapter 5 (page 15 for DEPT 4-20 / EST 4-20; page 18 for DEPT-P / EST-P / DEC / DEC-3; page 23 for DEPT-485 / EST-485). Programming modifications made while the instrument is powered up will not be accepted.*

The instrument must be powered by a 200-240 VAC 50/60 Hz voltage (100 -120 VAC 50/60 Hz is also available on request) using a 4 mm² (max.) cable connected to the screw type power supply terminals as shown in Fig. 2. The instrument's power supply does not require an earth connection. The instrument is not fitted with a protection fuse. A 50 mA T HBC fuse must therefore be connected to the power supply circuit.

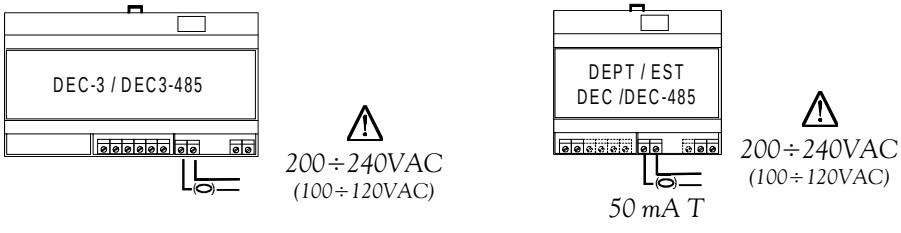


Fig.2

2.4 VOLTAGE MEASUREMENT CONNECTION

Using cables with max. cross-section of 4 mm^2, attach them to the voltage measurement screw terminals.

The following diagrams illustrate how to connect the terminals to the phases.

Follow the diagrams to make the correct voltage measurement connection in relation to the type of instrument used and the system in which it is installed.

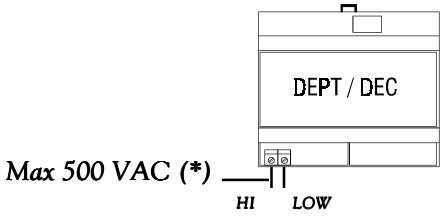


Fig. 3

(*) The 500 VAC limit is imposed by standards. The Full Scale is 750 VAC.

2.4.1 THREE-PHASE 3 -WIRE DELTA NETWORK (Δ)

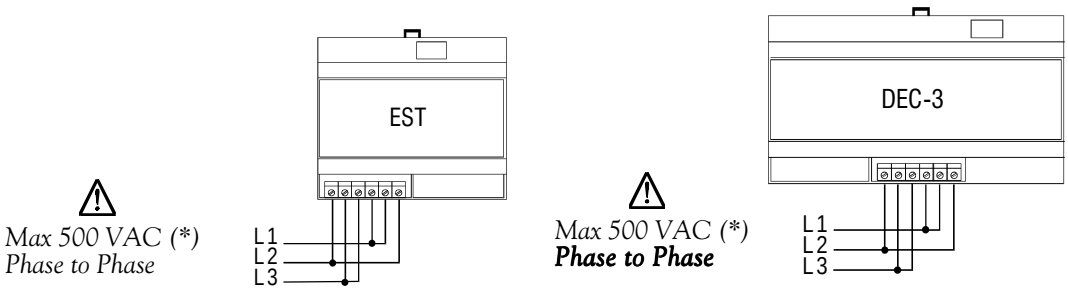


Fig. 4

(*) The 500 VAC limit is imposed by standards. The Full Scale is 750 VAC.

2.4.2 THREE-PHASE 4-WIRE STAR NETWORK (⅄)

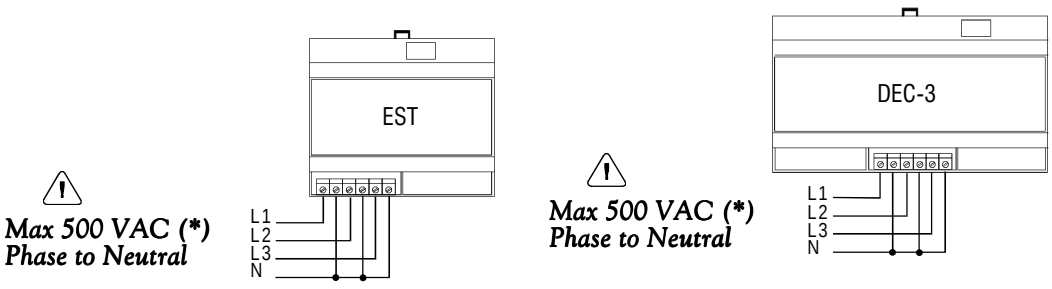


Fig. 5

(*) The 500 VAC limit is imposed by standards. The Full Scale is 750 VAC.

2.5 CURRENT MEASUREMENT CONNECTION

The instruments are equipped with cable holes (one for DEPT and DEC and three for EST and DEC-3) through which the current measurement cables must be fed uninterrupted.

Insert the current cables as shown in Fig. 6 (instructions are also given on the instrument label).

Use cables with max. external diameter of 7 mm.

P1 and P2 in the following diagrams indicate the correct direction of the current.

(*) The 500 VAC limit is imposed by standards. The Full Scale is 750 VAC.

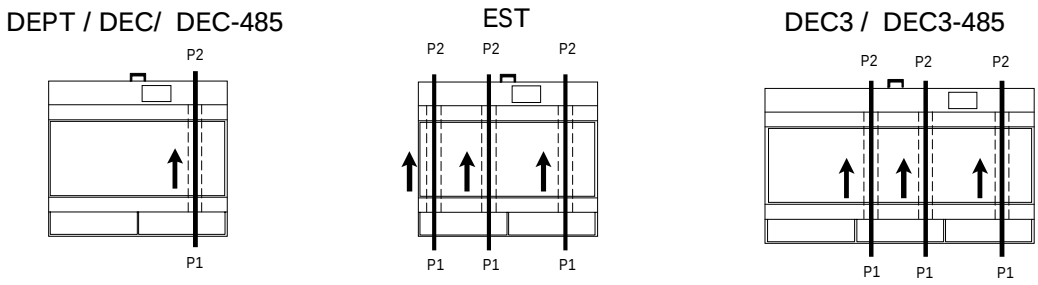


Fig. 6

N.B.: *If the voltage and/or current signal connection is accidentally inverted, the instrument's automatic compensation function corrects the inversion, thereby guaranteeing accurate readings.*

3 WIRING DIAGRAMS

This chapter contains the wiring diagrams and instructions required to connect the instrument.

☞***Note:***

The following wiring diagrams are applicable to all instruments with serial number (on label on side of instrument) greater than 15000 and used in conjunction with ELEXTOOL software.
In all other cases (DEC, DEC-3, DEPT-P and EST-P) instruments may only be programmed using the relative Programming dip-switches.

☞***Note:***

Phases L1-L2-L3 shown in the wiring diagrams need not necessarily correspond with those of the three-phase system.
The voltage and current signal connections must however always correspond.
The wiring diagrams indicate the voltage and current polarities which must be observed.
In the case of inversions the instrument automatically corrects them (except when CO-GENERATION mode is selected using ELEXTOOL software).

3.1 DEPT AND DEC WIRING DIAGRAMS

3.1.1 Single-phase network

The CT may be connected to both the phase and neutral.

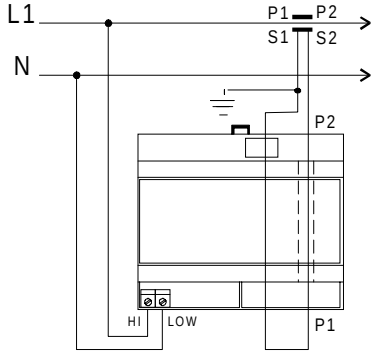


Fig. 7

3.1.2 Balanced Three-phase network

The CT may be connected to any of the three phases selected by the user. The phase matching between voltage and current signals must however always be observed.

I.E. Examples: I = L1 V = L2 - L3
I = L2 V = L3 - L1
I = L3 V = L1 - L2

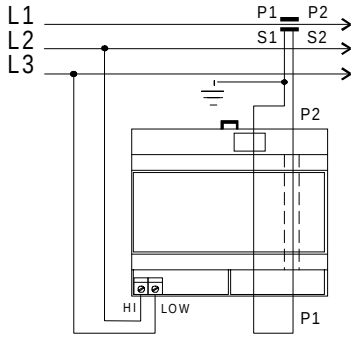


Fig. 8

3.1.3 High voltage network with CT and VT

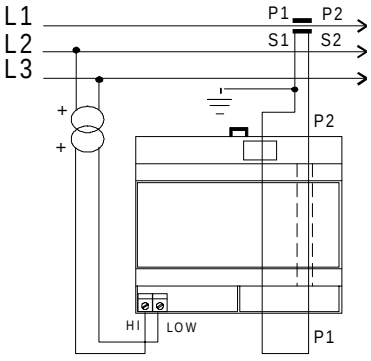


Fig. 9

3.2 EST, DEC-3 and DEC3-485 WIRING DIAGRAMS

3.2.1 Three-phase 3 -wire delta network (Δ)

Figures 10, 11, 12, 13, 14, 14 A, 15, 16 and 17 indicate how to connect the voltage and current signal inputs (2 or 3 CTs) in an unbalanced three-phase 3-wire delta network (without neutral).

Voltage signal connection

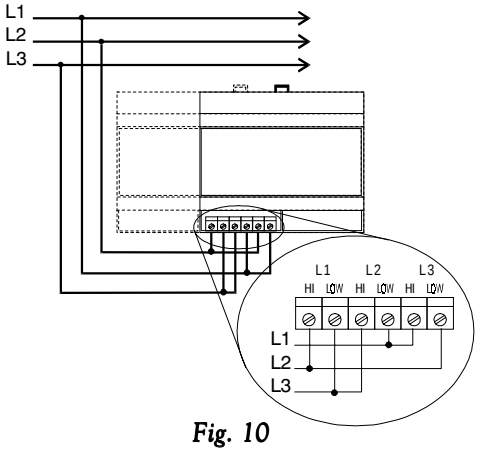


Fig. 10

Current signal connection with 3 CTs

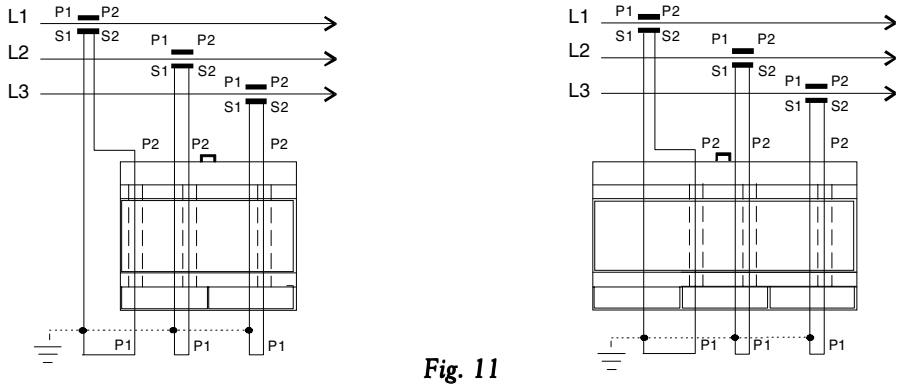
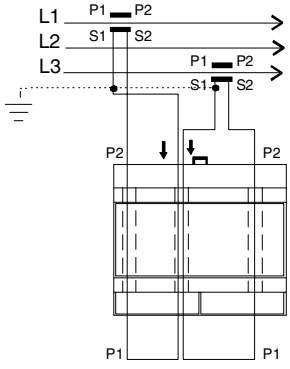


Fig. 11

Current signal connection with 2 CTs (L1 and L3)

☞**IMPORTANT:** *When connecting 2 CTs always follow the direction (orientation) of the CT current output as shown in the diagrams below.*

EST



DEC-3 e DEC3-485

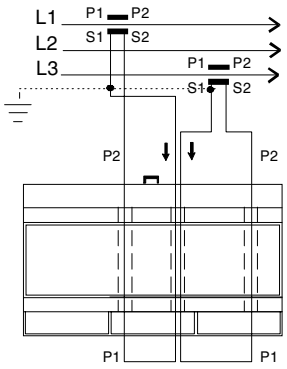
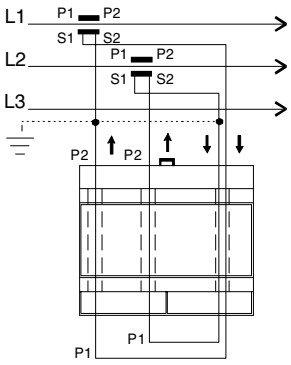


Fig. 12

Current signal connection with 2 CTs (L1 and L2)

☞**IMPORTANT**: *When connecting 2 CTs always follow the direction (orientation) of the CT current output as shown in the diagrams below.*

EST



DEC-3 e DEC3-485

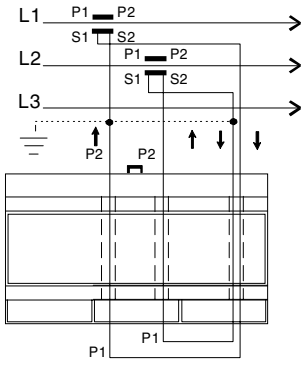


Fig. 13

❍ *Connection with 2 CTs in co-generation mode* ❍

Connection with 2 CTs (L1 and L2)

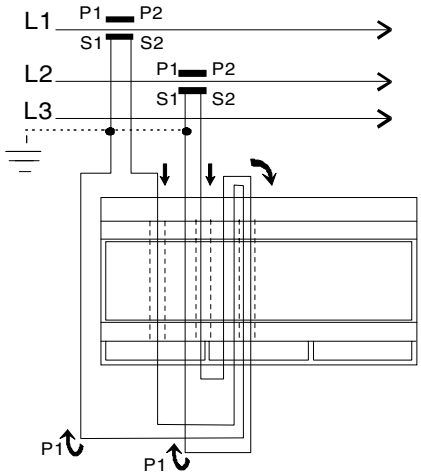


Fig. 14

Connection with 2 CTs (L1 and L3)

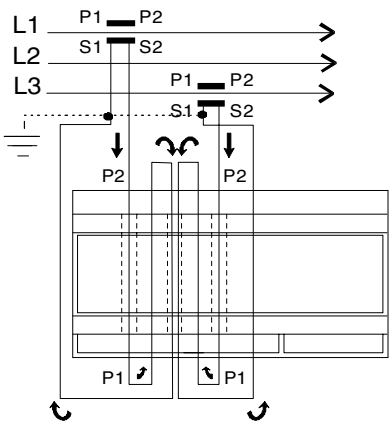


Fig. 14 A

3.2.2 High voltage Three-phase 3 -wire delta network with CT and VT (Δ)

Voltage signal connection with 3 VTs

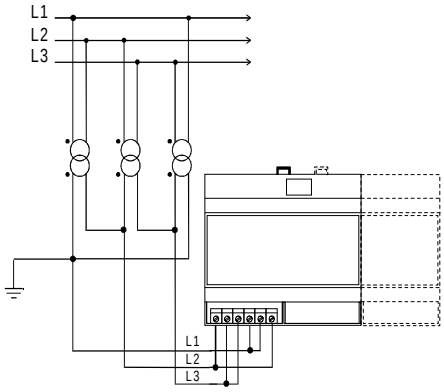


Fig. 15

Voltage signal connection with 2 VTs

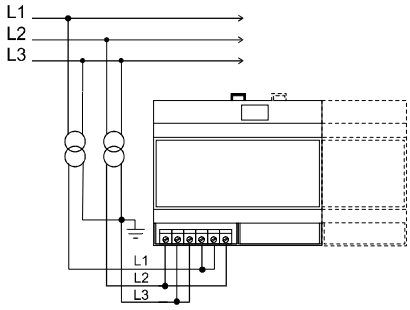


Fig. 16

☞ **IMPORTANT:** *Any one of the delta vertices may be earthed.*

Voltage signal connection with 2 VTs

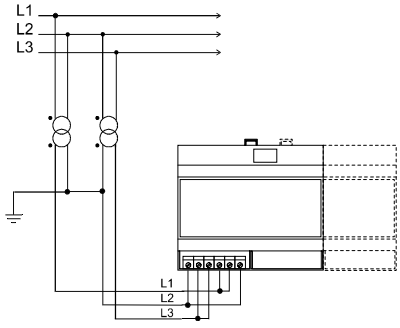


Fig. 17

Current signal connection

For the connection of CTs in medium or high voltage networks, follow the same procedure described for low voltage connections.

3.2.3 Three-phase 4-wire star network (Y)

Figures 18 and 19 below indicate how to connect voltage and current signal inputs in an unbalanced three-phase 4-wire star network.

Voltage signal connection

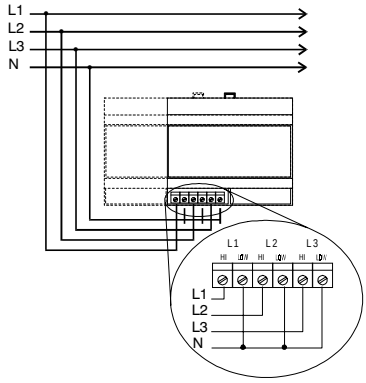


Fig. 18

Voltage signal connection with 3 VTs

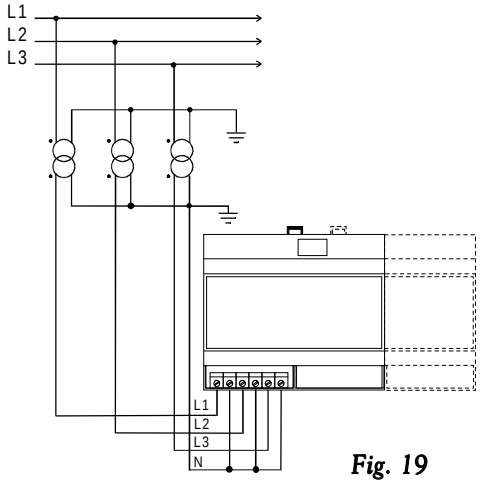


Fig. 19

Current signal connection with 3 CTs

EST

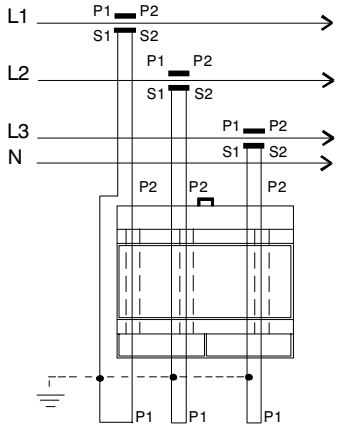


Fig. 20

DEC-3 e DEC3-485

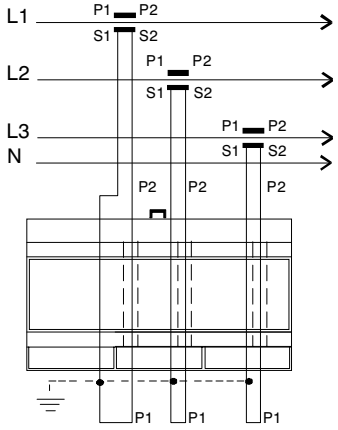
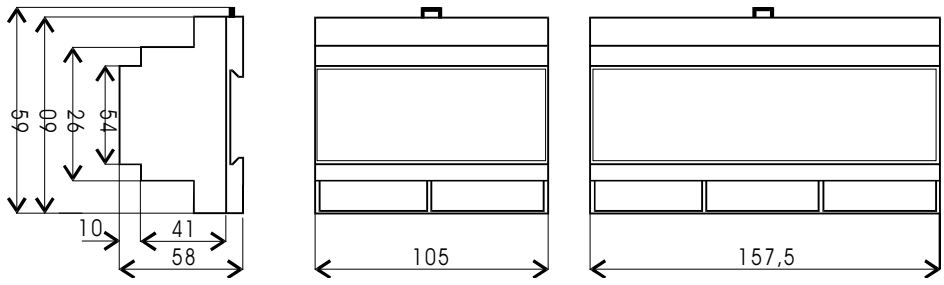


Fig. 21

4 TECHNICAL SPECIFICATIONS

4.1 General Specifications

- ***Inputs***
  Voltage: 500 V from 20 to 800 Hz [(1)]
  Current: 5 A from 20 to 800 Hz
  [(1)] *Limit imposed by standards. The measurement Full Scale is 750 VAC.*
- ***Input overload***
  Voltage: max 800 Vrms,
  peak 900 Vrms for 1 Sec.
  Current: max. 20 Arms,
  peak 100 Arms for 1 Sec.
- ***Number of scales:*** 3 current scales
  2 voltage scales
- ***Scale change response time:***
  1 Sec. (DEPT / DEC)
  1,5 Sec. (EST / DEC-3)
- ***Upper scale change:***
  occurs at 110% of the scale activated.
- ***Lower Scale change:*** when 100% of the scale below the one activated is reached (approximately 25% of the scale in use).
- ***Dimensions***:
  Length = 105 mm (6 DIN modules)
  = 157.5 mm (9 DIN modules)
  Height = 90 mm
  Depth = 58 mm



- ***Weight***: 0,5 Kg.

- ***Protection class:*** Instrument = IP20
  Front panel = IP40

- ***Temperature range:***
  -10°C to +60°C (DEPT / EST)
  -10°C to +40°C (DEC / DEC-3)

- ***Relative humidity:*** Max. 90%

- ***Condensation:*** Not permitted

- ***Isolation:*** In compliance with group C VDE 0110 standards for 500 VACrms operating voltages.

- Isolation resistance between terminals and outer casing: ³ ***500 MW***

- ***Isolation voltage between input connectors:***tested at 2000 Vrms at 50 Hz for 60 sec.

- ***Vibration resistance:*** 10-55 Hz

- ***Power Supply:***
  200÷240 VAC ± 10% 50/60 Hz
  100÷120 VAC ± 10% 50/60 Hz (*on request*)

- ***Consumption***: 3VA

- ***Reference standards***:
  Safety: IEC 1010 and VDE 411, Class 2 with external cabinet Isolation VDE 0110, Class C

- ***Compatibility electromagnetic:***
  Immunity EN 50082-1;1992 EN 50082-2; *1994*
  Emissions EN 55022:1988 - class B

- ***Compliance with IEC 1036 directive:*** energy measurement, class 1 accuracy.

4.2 Display specifications

- ***Measuring method:*** Fixed sampling and analog/digital conversion.
- ***Sampling frequency***: *2400 Hz*
- ***Number of samples per phase***: *240*
- ***Measuring interval:*** *1 Sec. (DEPT/DEC/DEC-485); 1.5 Secs. (EST/DEC-3/DEC3-485)*
- ***Zero self-regulation***: *At every measurement*
- ***Offset***: *Automatic amplifier offset correction*
- ***Secondary measurement error (Powers)***: *1% of the measurement between 5% and 120% of the Full Scale.*

Sensitivity, Full Scale and accuracy of AC voltage			
Range Rated	Sensitivity	Full Scale	ε from 20% F.S. to 110% F.S.
			DEPT / EST DEC / DEC-3
150 Vrms	75 mV*	150 Vrms	0,4% Rdg.+0,1% F.S.
500 Vrms	400 mV	750 Vrms	0,4% Rdg. +0,1% F.S.

**** Minimum readable signal: 10 V.***

Sensitivity, Full Scale and accuracy of AC current			
Range Rated	Sensitivity	Full Scale	ε from 20% F.S. to 110% F.S.
			DEPT / EST DEC / DEC-3
0,3 A	0,15 mA*	0,3 mA	0,4% Rdg.+0,1% F.S.
1,25 A	0,6 mA	1,25 A	0,4% Rdg.+0,1% F.S.
5 A	3 mA	5,00 A	0,4% Rdg.+0,1% F.S.

**** Minimum readable signal :20 mA.***

- ***Crest factor:*** *2.3 minimum (on both the input voltage and current)*

4.3 FORMULAE USED

4.3.1 Single-phase formulae (DEPT/DEC/DEC-485)

RMS Voltage

$$V_{1RMS} = \sqrt{\sum_{i=1}^{240} (V_{1i})^2 \Big/ 240}$$

RMS Current

$$I_{1RMS} = \sqrt{\sum_{i=1}^{240} (I_{1i})^2 \Big/ 240}$$

Active Power

$$P_1 = \frac{\sum_{i=1}^{240} V_{1i} \times I_{1i}}{240}$$

Apparent Power

$$S_1 = V_{1RMS} \times I_{1RMS}$$

Reactive Power

$$Q_1 = \sqrt{S_1^2 - P_1^2}$$

Power Factor

$$(P.F.)_1 = P_1 / S_1$$

4.3.2 Three-phase formulae(EST/DEC-3/DEC3-485)

- *RMS Phase Voltage (applicable to each phase)*

$$V_{1RMS} = \sqrt{\sum_{i=1}^{240} (V_{1i})^2 \Big/ 240}$$

- *RMS Phase Current (applicable to each phase)*

$$I_{1RMS} = \sqrt{\sum_{i=1}^{240} (I_{1i})^2 \Big/ 240}$$

- *Active Phase Power (applicable to each phase)*

$$P_1 = \frac{\sum_{i=1}^{240} V_{1i} \times I_{1i}}{240}$$

- *Apparent Phase Power (applicable to each phase)*

$$S_1 = V_{1RMS} \times I_{1RMS}$$

- *Reactive Phase Power (applicable to each phase)*

$$Q_1 = \sqrt{S_1^2 - P_1^2}$$

- *Phase Power Factor (applicable to each phase)* $(P.F.)_1 = P_1 / S_1$
- *Three-phase Voltage (Δ)* $V_{3\Phi} = \frac{V_{12} + V_{23} + V_{31}}{3}$
- *Three-phase Voltage (Y)* $V_{3\Phi} = \frac{V_{12} + V_{23} + V_{31}}{3}\sqrt{3}$
- *Three-phase Active Power* $P_{3\Phi}=P_1+P_2+P_3$
- *Three-phase Reactive Power* $Q_{3\Phi}=Q_1+Q_2+Q_3$
- *Three-phase Apparent Power* $S_{3\Phi} = \sqrt{P^2_{3\Phi} + Q^2_{3\Phi}}$
- *Three-phase Current* $I_{3\Phi} = \frac{S_{3\Phi}}{V_{3\Phi}\sqrt{3}}$
- *Three-phase Power Factor* $(P.F.)_{3\Phi} = P_{3\Phi} / S_{3\Phi}$

5 TRANSDUCER OPERATION

5.1 EST 4-20 and DEPT 4-20

DEPT 4-20 and EST 4-20 units are electrical parameter transducers with a 4-20 mA output, specially designed for connection to recorders and remote indicators, for process control and regulation and data acquisition systems.

5.1.1 Functions available

- Measurement selection: Active Power / Reactive Power / Power Factor / Apparent Power
- Connection type selection: Single-phase or Balanced Three-phase (DEPT 4-20) Unbalanced Three-phase 4-wire star or 3-wire delta (EST 4-20)
- Voltage Full Scale selection: 65V, 125V, 250V or 500V
- Current Full Scale selection: 1A or 5A
- Integration period selection for average power calculations: instantaneous, 10, 15 or 30 minutes

Functions are easy to program using the 8-pole dip-switch (see Fig. 22) shown in para. 5.1.2.

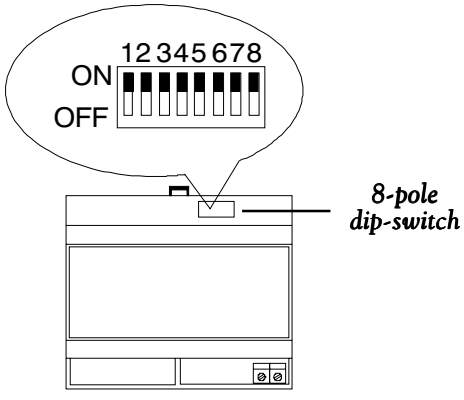


Fig. 22

5.1.2 Instrument programming

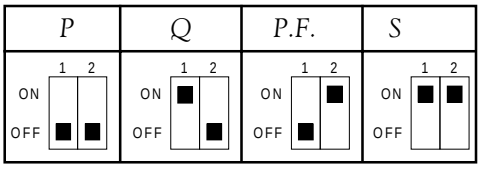
The dip-switches are protected by a plastic cover mounted on the instrument case. This cover may be removed by inserting a screwdriver in the slot and prising off.

Fig. 23

☞**IMPORTANT**: *Set the operating functions before powering up the unit. Program setting changes made when the instrument is energised will not be accepted. To change program settings power down the instrument and power up again.*

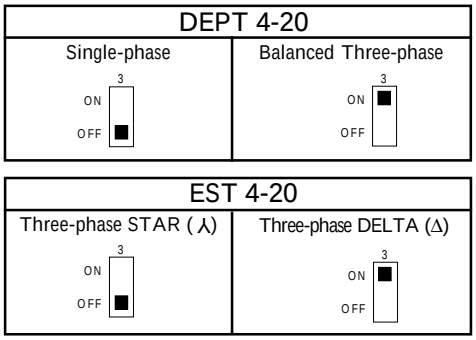
- ***Measurement selection (Dip-switches 1-2)***

Select the required parameters by setting dip-switches 1 and 2 as shown in the diagram below.
The following parameters are available:
P = Active Power
Q = Reactive Power
P.F. (Cos Φ) = Power Factor
S = Apparent Power



- ***Connection type selection (Dip-switch 3)***

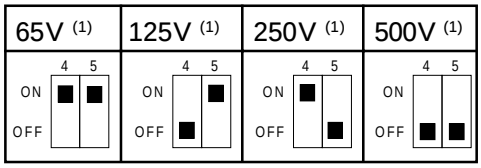
Select the required connection type by setting dip-switch 3 as shown below.



- ***Voltage Full Scale selection (Dip-switches 4-5)***

Nota: (1) Full Scales are mathematical multiplication factors and do not in any way limit the input voltages and currents.
The Full Scale is the No. used in the instrument F.S. calculation formula.
For example, a 125 V F.S. may be selected for a 400 V input, or alternatively a 1A F.S. for a 5A CT.

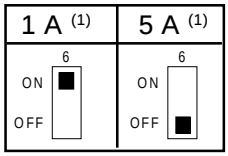
Four voltage Full Scales are available: 65 V, 125 V, 250 V and 500 V. Select the required Full Scale by setting dip-switches 4 and 5 as shown below.



N.B.: *EST 4-20 voltage Full Scales apply to both 4-wire star and 3-wire delta Phase to Phase voltages .*

• *Current Full Scale selection (Dip-switch 6)*

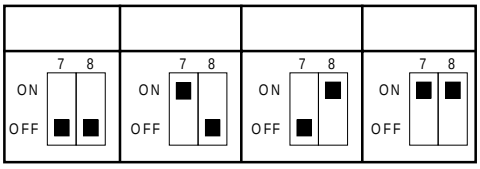
Two current Full Scales are available: 1 A and 5 A. Select the required Full Scale by setting dip-switch 6 as shown below.



N.B.:*EST-4-20 current Full Scales apply to Three-phase measurements.*

• *Integration period selection (Dip-switches 7-8)*

Power readings may also be calculated as average values over programmable integration periods of 10, 15 or 30 minutes. Select the required integration period by setting dip-switches 7 and 8 as shown below.



5.1.3 Output connection

The instrument is equipped with two screw terminals for the 4-20 mA output. The output connection to recorders, ammeters, remote indicators, etc., must be made using a max. cable size of 4 mm^2. The output is galvanically isolated with a max. load impedance of 500 Ω.

The maximum digital to 4-20 mA conversion error is ± 0.2% of the measurement. Connect the instrument taking care to follow the "+" and "-" signs on the label next to the output terminals. The connection procedure is illustrated in Fig. 24 below.

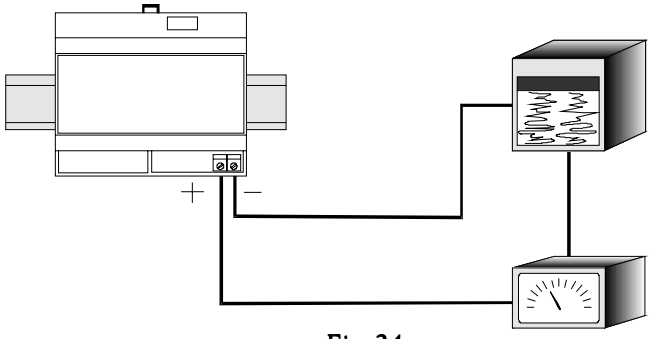


Fig. 24

5.1.4 Measurement reading

The instrument output supplies a 4 to 20 mA current proportional to the measurement of the selected parameter (dip-switches 1 and 2), voltage Full Scale (dip-switches 4 and 5) and set current (dip-switch 6) for the CT multiplication factor.

DEPT 4-20:

Single-phase

F.S.= Voltage F.S. x Current F.S. x K

Example: V_{FS} = *500 V* I_{FS} = *5 A*
CT = 1000/5 K= 200

P_{FS} = 500 kW

Three-phase

F.S.=Voltage F.S. x Current F.S. x Ö3 xK

Example: V_{FS} = *500 V* I_{FS} = *5 A*
CT = 1000/5 K= 200

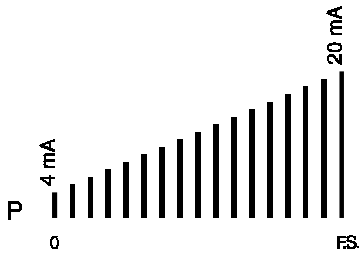
P_{FS} = 865 kW

F.S.= Voltage F.S. x Current F.S. x Ö3 xK

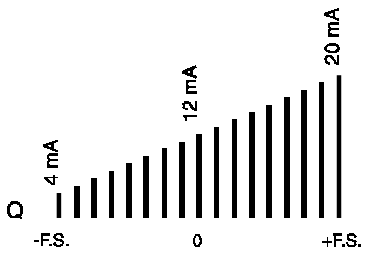
Example: V_{FS} = 500 V I_{FS} = 5 A
CT = 1000/5 K= 200

P_{FS} = 865 kW

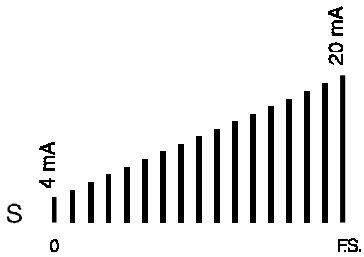
• *P (Active power))*



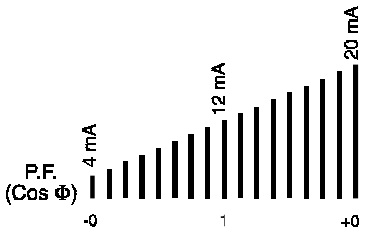
• *Q (Reactive power)*



• *S (Apparent power)*



• *P.F. Cos Φ (Power factor)*



5.2 DEPT-P, DEC, EST-P and DEC-3

DEPT-P, DEC, EST-P and DEC-3 units are electrical parameter transducers with a pulse output, specially designed as a PLC or PC interface in automation systems, process control, consumption monitoring, electrical energy cost optimisation and AC/DC load driving applications.

5.2.1 Functions available

- *Measurement selection:*
  Active Energy
  Apparent Energy
  Inductive Reactive Energy
  Capacitive Reactive Energy

- *Connection type selection:*
  Single-phase or balanced Three-phase (DEPT-P and DEC)
  Three-phase 4-wire star or 3-wire delta (EST-P and DEC-3)

- *Current Full Scale selection:* 1 A or 5 A

• CT primary rating selection: 14 typical values

Functions are easy to program using the 8-pole dip-switch (see Fig. 25) as shown in para. 5.2.2. Refer to page 25 (Fig. 23) for cover removal instructions.

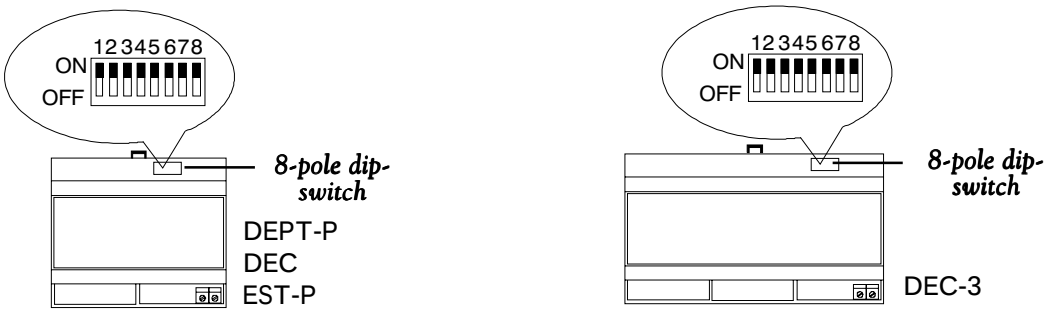


Fig. 25

5.2.2 Output pulse specifications

The length of the output pulse varies between 400 and 500 mSecs. (see figure 26 below). Pulse fractions are stored in an internal meter and supplied to the output as a complete pulse each time the meter accumulates a whole one.

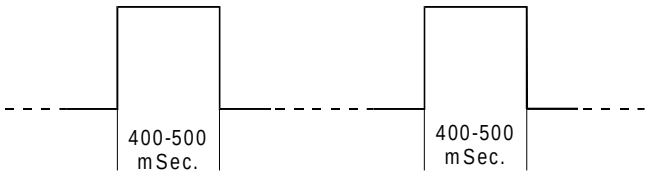


Fig. 26

5.2.3 Instrument programming

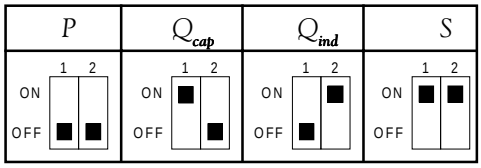
☞ **IMPORTANT:** *Set the operating functions before powering up the unit. Program setting changes made when the instrument is energised will not be accepted. To change program settings power down the instrument and power up again.*

• ***Measurement selection (Dip-switches 1-2)***

Select the required parameters by setting dip-switches 1 and 2 as shown in the diagram below.

The following parameters are available:

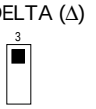
P = Active Energy/Power
Q_{cap} = Capacitive Reactive Energy/Power
Q_{ind} = Inductive Reactive Energy/Power
S = Apparent Energy/Power



• *Connection type selection (Dip-switch 3)*

Select the required connection type by setting dip-switch 3 as shown below.

DEPT-P / DEC	
Single-phase	Balanced Three-phase
	

EST-P / DEC-3	
Three-phase STAR(⅄)	Three-phase DELTA (Δ)
	

• *Current Full Scale selection (Dip-switch 4)*

Two current Full Scales are available: 1 A and 5 A.
Select the required Full Scale by setting dip-switch 4 as shown below.

1 A	5A
	

• *CT primary current selection (Dip-switches 5-6-7-8)*

The CT primary current is selected using dip-switches 5, 6, 7 and 8. Refer to the table on page 21 for available CT primary ratings.

It should be noted that the magnitude of the CT primary automatically determines the value of each pulse and hence, the resolution of an associated pulse counter.

A 7-digit electro-mechanical counter is mounted on the front panel of DEC and DEC-3 units to permit direct energy consumption readings (for more information see para. 5.2.4).

Examples:

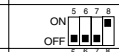
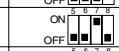
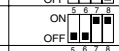
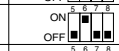
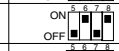
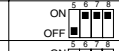
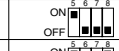
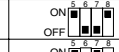
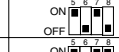
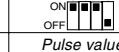
- CT = 20/5
  Pulse value = 0.1 kWh*
  Counter resolution = 999 999.9 kWh *

- CT = 200/5
  Pulse value = 1 kWh*
  Counter resolution = 9 999 999 kWh*

The instrument provides kWh, kVAh or kvarh readings depending on the parameter selected.

Accurate energy totals are guaranteed even in the case of very small loads.

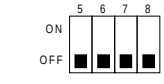
The instrument's internal floating point mathematics is able to count energy increments down to 10^{-4} of the pulse value.

CT primary current (Ampere)			Dip-switch settings 5-6-7-8
10	100	1000	
12	120	1200	
15	150	1500	
16	160	1600	
20	200	2000	
24	240	2400	
25	250	2500	
30	300	3000	
32	320	3200	
40	400	4000	
50	500	5000	
60	600	6000	
75	750	7500	
80	800	8000	
0,1 KWh	1 KWh	10 KWh	*Pulse value*
999 999,9	9 999 999	99 999 990	*Counter resolution (KWh)*

☞ **IMPORTANT**: *Do not set dip-switches 5, 6, 7 and 8 to position "ON" at the same time.*

Direct measurement of max. 5A loads:

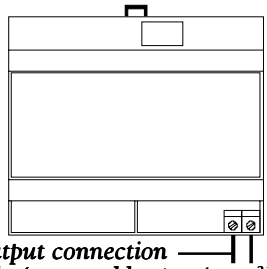
☞ **IMPORTANT**: ***in this condition the 1A/ 5A current Full Scale setting is not operative.***

Dip-switch settings (5-6-7-8)	Pulse value
	1 pulse = 10 Wh
Counter resolution (kWh)	99 999.99

5.2.4 Output connection

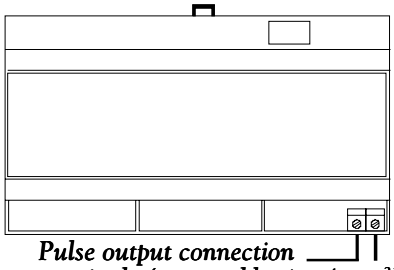
The pulse output is supplied directly to two screw terminals (Fig. 27) connected to the N.O. voltage-free contacts of an optomos solid state relay rated at 250 Vac/ dc 100 mA.

Connection to pulse counters, PLCs, etc., must be made using cables with max. cross-section of 4 mm^2.



DEPT-P
DEC
EST-P

Pulse output connection terminals (max. cable size 4 mm^2)



DEC-3

Pulse output connection terminals (max. cable size 4 mm^2)

5.2.5 DEC and DEC-3 counter labelling

DEC and DEC-3 units feature a non-resettable 7-digit electro-mechanical counter mounted on the front panel.

A set of 9 labels is supplied with these instruments to facilitate pulse counter reading.

You can therefore customise the instrument by choosing the appropriate label for the selected parameter (kWh, kVAh or kvarh) and CT primary range (see Fig. 28) and affixing it to the counter.

Example:

- *Selected parameter :* ***P= Active Energy/Power (kWh)***
- *Selected CT primary value:* ***300 A***

In the example the required label is located in the "kWh" row (selected parameter) and "100-800" column (CT primary range) as shown in Fig. 28.

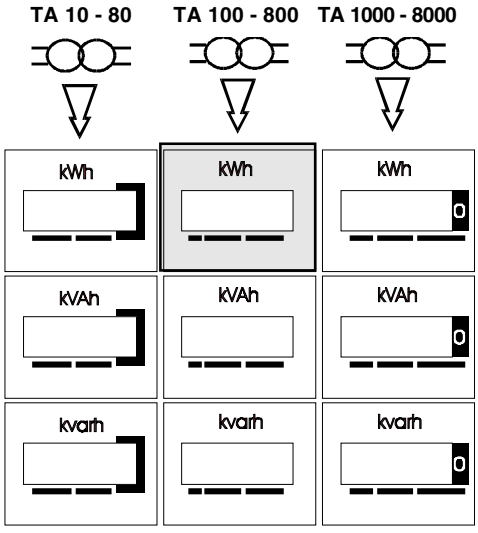


Fig. 28

5.3 DEPT-485 and EST-485

DEPT-485 and EST-485 units are electrical parameter transducers with an RS485 interface for network connection to a PC or PLC. Up to 32 instruments can be network-connected over a distance of up to 1000 m. without amplification. The system may be further expanded to a maximum of 247 measuring points using additional line amplifiers. DEPT-485 and EST-485 units are particularly suited for the following applications:

– data acquisition systems for quality control of production processes;
– networks for monitoring electrical energy consumption and the status of components (eg: motors, transformers, etc.);
– maximum demand control and load shedding in combination with PLCs or PC- networked applications for the reduction of energy bills;
– computerised energy cost-accounting and division of electrical energy bills between departments, etc.

Functions are controlled by an RS485 interface using MODICON's MODBUS communication protocol.

5.3.1 Functions available

- ***12 measurements are available on DEPT-485 units:***

  U = RMS voltage
  I = RMS current
  P = Active Power

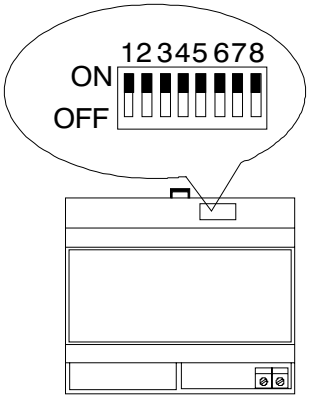
$P.F.$ = Power Factor (Cos Φ)
S = Apparent Power
Q = Reactive Power
P_m = Average Active Power
S_m = Average Apparent Power
P_{MD} = Maximum Active Power
S_{MD} = Maximum Apparent Power
E_A = Active Energy Consumption (kWh)
E_R = Reactive Energy Consumption (kvarh)

- *22 measurements are available on EST-485 units:*

U = RMS voltage*
I = RMS current*
P = Active Power*
$P.F.$ = Power Factor (Cos Φ)
S = Apparent Power
Q = Reactive Power
P_m = Average Active Power
S_m = Average Apparent Power
P_{MD} = Maximum Active Power
S_{MD} = Maximum Apparent Power
E_A = Active Energy Consumption (kWh)
E_R = Reactive Energy Consumption (kvarh)
H_Z = Frequency

* EST-485 provides both the three-phase and phase measurements of U, I and P values. The three-phase voltage is calculated as the average value of the three phase to phase voltages, while the three-phase current is the current equivalent to a balanced and symmetrical system (see formulae on page 14). The average power values are calculated by sliding window mathematics.

- *Programmable CT and VT ratios for direct readings*
- *Programmable integration period for average power calculations*
- *Reset of:* Average Active Power
  Average Apparent Power
  Maximum Demand on Active Power
  Maximum Demand on Apparent Power
  Energy counters
  Peak values
- *Integration period synchronisation signal for average power calculations.*
  The following functions are set using the 8-pole dip-switch illustrated in Fig. 29 below.
- *Transmission speed selection:*
  2400, 4800 or 9600 BAUD
- *Connection type selection:*
  Single-phase or balanced Three-phase (DEPT-485)
  Unbalanced Three-phase 4-wire star or 3-wire delta (EST-485)
- *Parity selection (PARITY/ NO PARITY)*
- *Parity type selection (EVEN/ODD)*



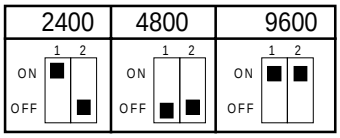
5.3.2 Instrument programming

☞*Measurement paramete rs such as CT and VT values and the instrument's network address must be programmed using MODBUS functions or more simply, the ELEX program supplied by ELECTREX.*

☞*IMPORTANT*: Set the operating functions before powering up the unit. Program setting changes made when the instrument is energised will not be accepted. To change program settings power down the instrument and power up again.

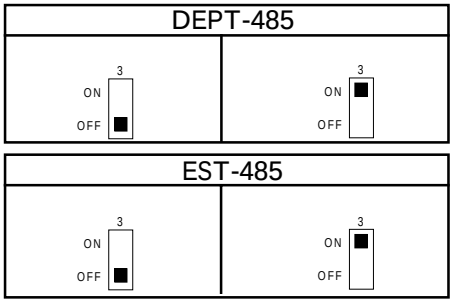
• *Transmission speed selection (Dip-switches 1-2)*

Three transmission speeds (2400, 4800 and 9600 BAUD) may be selected using dip-switches 1 and 2.

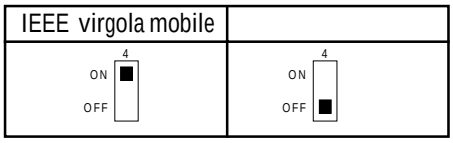


• *Connection type selection (Dip-switch 3)*

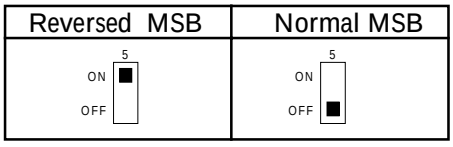
Select the required connection type by setting dip-switch 3 as shown below.



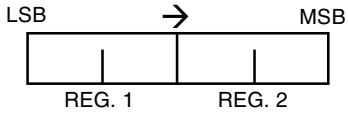
• *Data format selection (Dip-switch 4)*



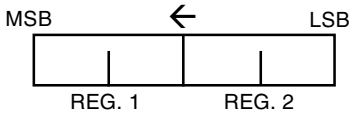
• *Reversed MSB / Normal MSB selection (Dip-switch 5)*



Normal MSB



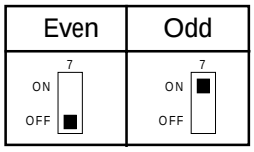
Reversed MSB



☞ *IMPORTANT*: Dip-switch 6 is not used.

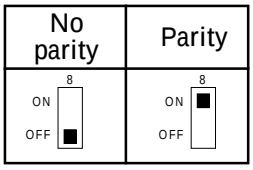
• *Parity type selection (Dip-switch 7)*

Select the required parity type (EVEN or ODD) by setting dip-switch 7 as shown below.



• *Parity selection (Dip-switch 8)*

Select the required parity (PARITY or NO PARITY) by setting dip-switch 8 as shown below.



5.3.3 Specifications of RS485 transmission and reception procedure

Factory setting:

ADDRESS	= 27
DATA FORMAT	= BCD
BAUD	= 4800
DATA BIT	= 8
STOP BIT	= 2
NO PARITY	

DEPT-485 and EST-485 units use a data communication system based on MODBUS protocol.

MODBUS functions and the use of registers are detailed in a special technical document available on request from ELECTREX S.r.l.

5.3.4 Output connection

The instrument is equipped with three terminals for connection of the output to the RS485 interface (Fig. 30).

The output connection must be made using a twisted pair.

The instrument is also equipped with a terminal for connection of the shield (sheath) required for network installations in environments prone to heavy interference or strong currents.

Use a twisted pair cable with minimum cross-section of 0.36 mm^2 (22 AWG) and capacity of less than 60 pF/m (ie: BELDEN cable type EIA RS485 - Ref. 3105 A).

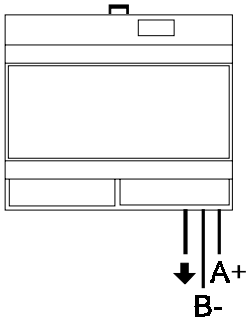


Fig. 30

5.3.5 Twisted pair connection

If the environment in which the instruments are installed is not prone to interference or strong currents, the connection may be made using an unshielded twisted pair.

Line amplifiers must be used if the distance between the PC and instruments exceeds 1000 m. or if more than 32 instruments are installed.

The PC is equipped with an RS232 interface. A RS232/RS485 converter must therefore be used to connect the twisted pair (the cables are identified by the letters “A” and “B”).

Connect a line termination resistor (R_T = 100 Ω - 120 Ω) between the two twisted pair cables leading from the converter at the end of the network (last instrument connected).

The instruments must be connected to the twisted pair so that the terminals marked “A” (instrument label) are connected to cable “A” (red) and the terminals marked “B” are connected to cable “B” (white) at the output of the RS232/RS485 converter (See Fig. 31).

5.3.6 Shielded twisted pair connection

If the environment in which the instruments are installed is prone to interference or strong currents, the connection must be made using a shielded twisted pair (2x0.25).

Line amplifiers must be used if the distance between the PC and instruments exceeds 1000 m. or if more than 32 instruments are installed.

The PC is equipped with an RS232 interface. A RS232/RS485 converter must therefore be used to connect the twisted pair (the cables are identified by the letters "A" and "B" and the shield by "⏚").

Connect a line termination resistor (R_T = 100 Ω - 120 Ω) between the two twisted pair cables leading from the converter at the end of the network (last instrument connected). The shield must be earthed.

The instruments must be connected to the twisted pair so that the terminals marked "A" (instrument label) are connected to cable "A", the terminals marked "B" are connected to cable "B" and the terminals marked "⏚" are connected to the shield at the output of the RS232/RS485 converter (see Fig. 32).

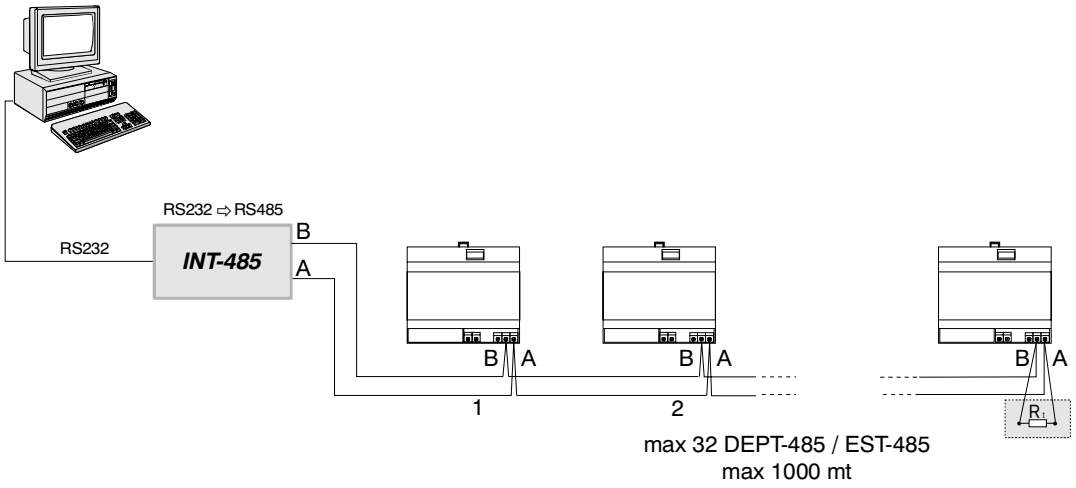


Fig. 31

☞ *If an interface other than INT-485 is installed make sure it is fitted with resistor R_t and if not, install one during the connection phase following the instructions in Fig. 31.*

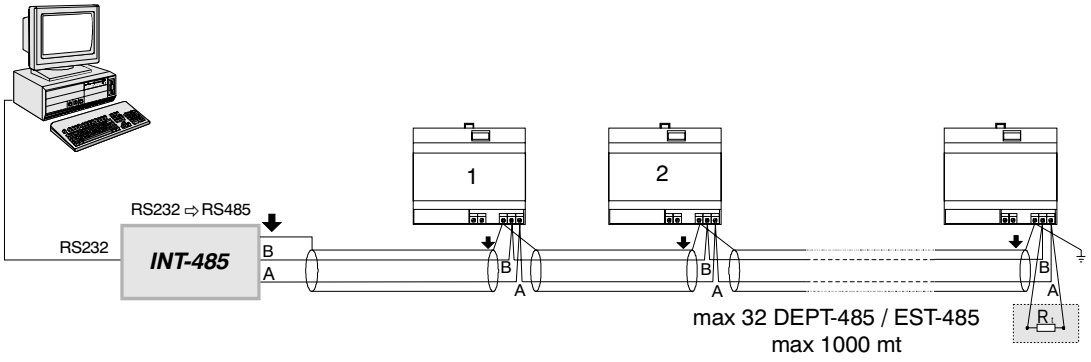


Fig. 32

☞ *If an interface other than INT-485 is installed make sure it is fitted with resistor R_t and if not, install one during the connection phase following the instructions in Fig. 32.*

Examples of a multiple instrument connection:

• *Example 1:* **CORRECT** *connection*

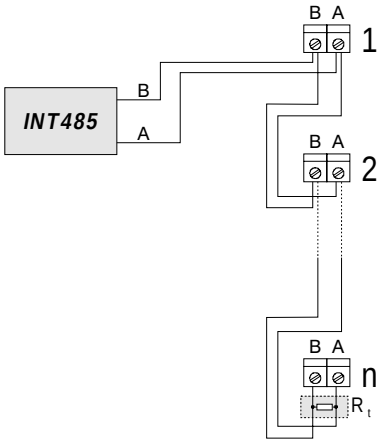


Fig. 33

• *Example 2:* **INCORRECT** *connection*

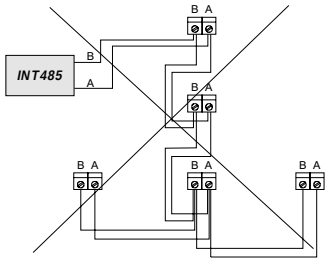


Fig. 33-A

• *Example 3:* **CORRECT** *connection*

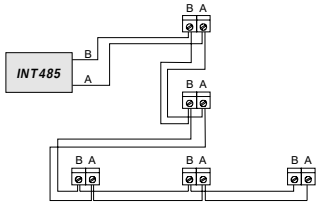


Fig. 33-B

The transmission/reception protocol used by the RS485 interface (MODBUS) permits the creation of data collection systems with up to 247 measurement points. A maximum of 32 instruments can be connected on a common line over a distance of up to 1000 m from the PC. If the number of instruments exceeds 32 or the distance between them and the PC is over 1000 m, line amplifiers must be used to guarantee correct data transmission/ reception (see Fig. 34 below).

5.4 DEC-485 and DEC3-485

The wiring diagrams and output specifications for DEC-485 and DEC3-485 are the same as those specified for DEPT-485 and EST-485 units (see para. 5.3 of this manual).

☞ ***Note:*** *DEC-485 and DEC3-485 instruments also feature an on-board electro-mechanical counter for kWh totals.*
The pulse "weight" value may be modified to satisfy different requirements (ie: 1/10 kWh) by using the ELEX software version 3.0 or higher.

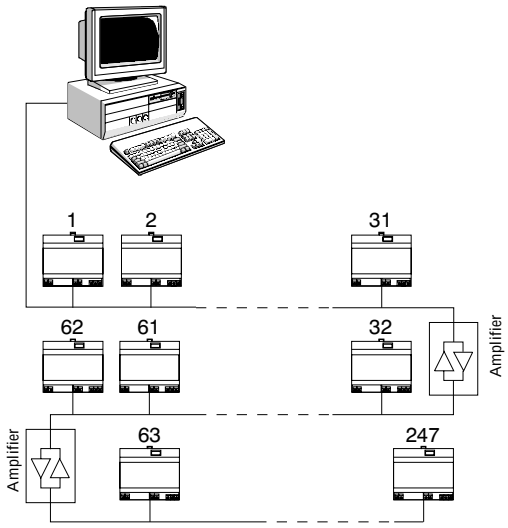


Fig. 34

5.5 Connection of over 32 instruments (or instruments installed over 1000 m from the PC)

An amplifier must be installed in systems containing more than 32 instruments or when instruments (even if less than 32) are installed over 1000 m from the PC.

The amplifier connection is illustrated in Fig. 35 below.

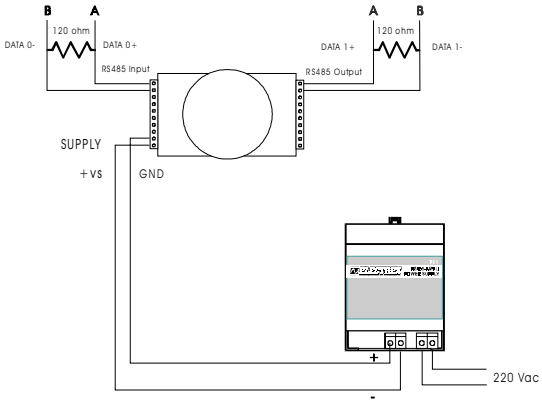


Fig.35

WARNING :
ELECTREX declines any liability for damages to property or persons due to improper use or misuse of the product.

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